

CLAIMS

I claim:

- 5 1. A device for monitoring moisture content level of a solid dielectric material inside an enclosure and a corresponding bubble formation temperature within the enclosure, said solid dielectric material being immersed in a dielectric fluid, said dielectric fluid filling said enclosure, said solid dielectric material and said dielectric fluid having a respective moisture content, said solid dielectric
- 10 material and said dielectric fluid having known water solubility properties varying with temperature thereof, said dielectric fluid having a gas content level thereof, said enclosure having pressure related data thereof, said device comprising:
- a moisture measuring means for measuring moisture content level of said dielectric fluid;
 - 15 - a temperature measuring means for measuring temperature level of said dielectric fluid; and
 - an electronic circuit means for computing said moisture content level of said solid dielectric material and said corresponding bubble formation temperature, said electronic circuit means being electrically connected to both
 - 20 said moisture measuring means and said temperature measuring means, said electronic circuit means having said known water solubility properties of said solid dielectric material and said dielectric fluid stored therein, said electronic circuit means processing said fluid moisture content level and said fluid temperature level so as to determine said solid dielectric material moisture content level and
 - 25 said bubble formation temperature using said solid dielectric material moisture

content level, the dielectric fluid gas content level and the enclosure pressure related data.

2. The device of claim 1, wherein said electronic circuit means
5 includes a displaying means for displaying said solid dielectric material moisture content level and said corresponding bubble formation temperature, said displaying means being electrically connected to said electronic circuit means.

3. The device of claim 1, including an operator interfacing means
10 for an operator to interface with said electronic circuit means, said operator interfacing means being electrically connected to said electronic circuit means so as to allow said known water solubility properties of said solid dielectric material and said dielectric fluid, the dielectric fluid gas content level and the enclosure pressure related data to be provided to and stored in said electronic circuit
15 means.

4. The device of claim 1, wherein said electronic circuit means is remotely electrically connected to both said moisture measuring means and said temperature measuring means so as to allow said moisture measuring means
20 and said temperature measuring means to be located in a generally inaccessible location.

5. The device of claim 1, including an operator interfacing means for an operator to interface with said electronic circuit means, said operator
25 interfacing means being electrically connected to said electronic circuit means,

said electronic circuit means providing a sensor location menu through said operator interfacing means so as to allow an operator to select a specific location of both said moisture measuring means and said temperature measuring means within said enclosure, whereby said specific location affecting determination of said solid dielectric material moisture content level and said corresponding bubble formation temperature by said electronic circuit means.

6. The device of claim 2; including:

- a second moisture measuring means for measuring second moisture content level of said dielectric fluid, said electronic circuit means comparing said first and second dielectric fluid moisture content levels and calculating a relative difference therebetween relative to said first dielectric fluid moisture content level, said electronic circuit means displaying on said displaying means either a warning message when said relative difference is equal or larger than a predetermined value or said solid dielectric material moisture content level and said corresponding bubble formation temperature when said relative difference is smaller than said predetermined value;

- whereby said second moisture measuring means being a reference moisture measuring means to enable detection of malfunction of said device.

7. The device of claim 2, including:

- a second temperature measuring means for measuring second moisture temperature level of said dielectric fluid, said electronic circuit means processing said first and second fluid temperature levels and said fluid moisture content level so as to determine first and second solid dielectric material moisture content

levels respectively, said electronic circuit means displaying on said displaying means an average of said first and second solid dielectric material moisture content levels and said corresponding bubble formation temperature.

5 8. The device of claim 7; wherein said first and second temperature measuring means are located adjacent bottom and top regions of the enclosure, respectively.

9. The device of claim 2, including:

10 - a second moisture measuring means for measuring second moisture content level of said dielectric fluid, said electronic circuit means comparing said first and second dielectric fluid moisture content levels and calculating a relative difference therebetween relative to said first dielectric fluid moisture content level, said electronic circuit means processing said first and second fluid moisture
15 content levels and said fluid temperature level so as to determine first and second solid dielectric material moisture content levels respectively, said electronic circuit means displaying on said displaying means either a warning message when said relative difference is equal or larger than a predetermined value or an average of said first and second solid dielectric material moisture
20 content levels and said corresponding bubble formation temperature when said relative difference is smaller than said predetermined value;

- whereby said second moisture measuring means being at least a reference moisture measuring means to enable detection of malfunction of said device.

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10. The device of claim 1, wherein the pressure related data includes a pressure level within the enclosure, and wherein said device further includes a pressure measuring means for measuring pressure level within the enclosure, said electronic circuit means being electrically connected to said pressure measuring means.

11. A method for monitoring moisture content level of a solid dielectric material inside an enclosure and a corresponding bubble formation temperature within the enclosure, said solid dielectric material being immersed in a dielectric fluid, said dielectric fluid filling said enclosure, said solid dielectric material and said dielectric fluid having a respective moisture content, said solid dielectric material and said dielectric fluid having known water solubility properties varying with temperature thereof, said dielectric fluid having a gas content level thereof, said enclosure having pressure related data thereof, said method comprising the following steps:

a) measuring moisture content level of said dielectric fluid using a moisture detector;

b) measuring temperature level of said dielectric fluid using a temperature detector; and

c) computing said solid dielectric material moisture content level and said corresponding bubble formation temperature using a processor electronic circuit, said electronic circuit being electrically connected to both said moisture detector and said temperature detector, said electronic circuit having said known water solubility properties of said solid dielectric material and said dielectric fluid stored therein, said electronic circuit processing said fluid moisture content level and

said fluid temperature level so as to determine said solid dielectric material moisture content level and said bubble formation temperature using said solid dielectric material moisture content level, the dielectric fluid gas content level and the enclosure pressure related data.

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12. The method recited in claim 11, including the step of:

d) displaying said solid dielectric material moisture level and said corresponding bubble formation temperature using a display, said display being electrically connected to said electronic circuit to receive said solid dielectric material moisture content level and said corresponding bubble formation temperature therefrom.

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13. The method recited in claim 12, wherein said display is remotely electrically connected to said electronic circuit.

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14. The method recited in claim 12, wherein step a) includes measuring a second moisture content level of said dielectric fluid using a second moisture detector; step c) includes said electronic circuit comparing said first and second dielectric fluid moisture content levels and calculating a relative difference therebetween relative to said first dielectric fluid moisture content level; and step d) includes displaying on said display either a warning message when said relative difference is equal or larger than a predetermined value or said solid dielectric material moisture content level and said corresponding bubble formation temperature when said relative difference is smaller than said predetermined value; whereby said second moisture detector being a reference

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moisture detector to enable detection of malfunction of said first moisture detector.

15. The method recited in claim 12, wherein step b) includes
5 measuring a second moisture content level of said dielectric fluid using a second moisture detector; step c) includes said electronic circuit processing said first and second fluid temperature levels and said fluid moisture content level so as to determine first and second solid dielectric material moisture content levels respectively; and step d) includes displaying on said display an average of said
10 first and second solid dielectric material moisture content levels and said corresponding bubble formation temperature.

16. The method recited in claim 15, wherein said first and second temperature detectors are located adjacent bottom and top regions of the
15 enclosure, respectively.

17. The method recited in claim 11, including the step of:
d) sending said solid dielectric material moisture content level and said corresponding bubble formation temperature to a remote unit so as to allow post-
20 processing thereof, said remote unit being electrically connected to said electronic circuit.

18. The method recited in claim 11, including after step b) the step of:

b1) providing an operator interface so as to allow said known water solubility properties of said solid dielectric material and said dielectric fluid, the dielectric fluid gas content level and the enclosure pressure related data to be provided therethrough; said operator interface being electrically connected to an electronic circuit for an operator to interface therewith and store said known water solubility properties of said solid dielectric material and said dielectric fluid, the dielectric fluid gas content level and the enclosure pressure related data therein.

19. The method recited in claim 18, wherein said operator interface is remotely electrically connected to said electronic circuit.

20. The method recited in claim 11, including after step b) the step of:

b1) providing an operator interface electrically connected to an electronic circuit for an operator to interface therewith, said electronic circuit providing a detector location menu through said operator interface so as to allow an operator to select a specific location of both said moisture detector and said temperature detector within said enclosure, whereby said specific location affecting determination of said solid dielectric material moisture content level and said corresponding bubble formation temperature by said electronic circuit.

21. The method recited in claim 12, wherein step a) includes measuring a second moisture content level of said dielectric fluid using a second moisture detector; step c) includes said electronic circuit comparing said first and second dielectric fluid moisture content levels and calculating a relative difference

therebetween relative to said first dielectric fluid moisture content level, said electronic circuit processing said first and second fluid moisture content levels and said fluid temperature level so as to determine first and second solid dielectric material moisture content levels respectively; and step d) includes
5 displaying on said display either a warning message when said relative difference is equal or an average of said first and second solid dielectric material moisture content levels and said corresponding bubble formation temperature when said relative difference is smaller than said predetermined value; whereby said second moisture detector being at least a reference moisture detector to enable detection
10 of malfunction of said first moisture detector.

22. The method recited in claim 11, wherein the pressure related data includes a pressure level within the enclosure, and wherein step a) includes measuring a pressure level of the enclosure using a pressure sensor; step c)
15 includes said electronic circuit being electrically connected to said pressure sensor.